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Title: Report to NCSP on FY21 DANCE and NEUANCE measurements of 233U(n,)

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Report to NCSP on FY21 DANCE and NEUANCE measurements of $^{233}\mathrm{U}(n,\gamma)$

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1 Experimental measurement 2021

In order to complete the statistics needed above 10 keV after the experiment performed in December 2020, a production measurement of the ^{233}U capture cross section, using the thick target ($\sim$20 mg) was proposed for the CY21 runcycle. Through collaboration with the DANCE experimental team, we arranged for the NEUANCE array to stay in place in the CY21 run cycle until the ^{233}U measurement was complete in June-July 2021, further reducing systematic uncertainties in the measurement.

The measurement was performed over 10 days with the 20 mg sample, and the 10 mg sample was placed in the beam for 1 day. The rest of the beam time was used to measure radioactive γ sources for energy calibration, and background measurements and tests to define the ^{233}U windows required during the data taking. The NEUANCE detector placed inside the DANCE cavity is shown in figure 1.

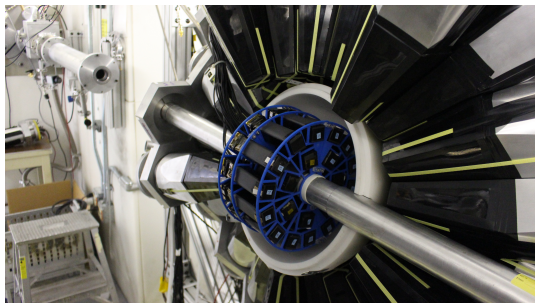

Figure 1: The NEUANCE instrument placed inside DANCE.

2 Fission tagging

After calibrating the DANCE and NEUANCE detectors for this new measurement, the analysis code has been modified to search for coincidences between the DANCE and NEUANCE channels. First, a time window of 5ns has been used to look for γs coincidences between the DANCE crystals to search for γ cascades. Then, a time window of 25ns has been used to look for coincidences between the γs from DANCE and the neutrons from NEUANCE. The events from DANCE found in coincidence with NEUANCE have been tagged as fission events and the rest of the DANCE events have been left untagged. The investigation of the fission tagging efficiency is still underway. The preliminary neutron energy spectra for the untagged events with multiplicity higher than 2 and the tagged events are shown in figure 2.

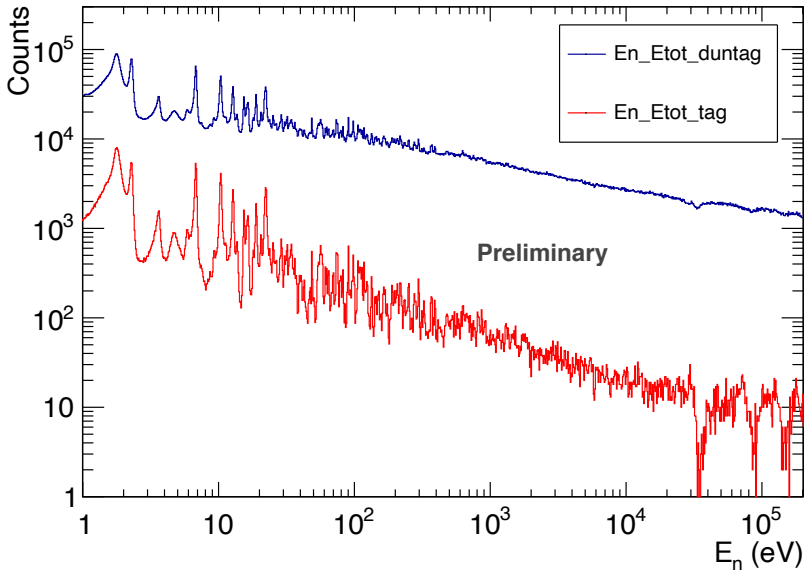

Figure 2: Preliminary tagged and untagged raw data spectra for 1h of data taking.

The preliminary crystal multiplicity versus the total energy of the cascade is shown in figure 3 for the fission tagged events (figure on the left) and the untagged events (figure on the right). Fission events can be observed in both, the tagged and untagged figures, the purpose of tagging is to define the shape of the fission γ-ray spectrum that can be subtracted from the untagged spectrum.

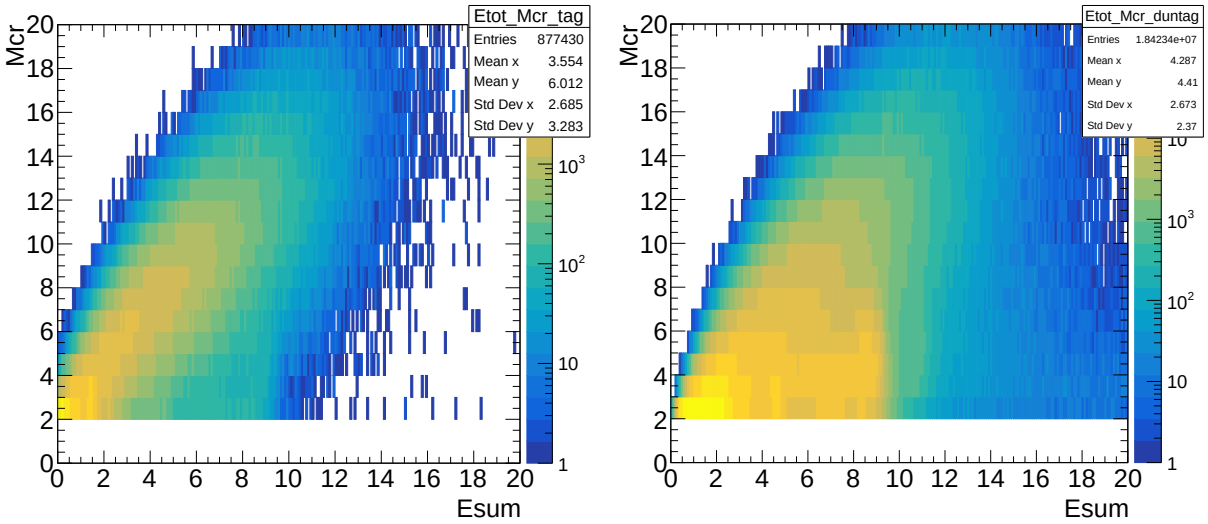

Figure 3: Preliminary tagged (figure on the left) and untagged (figure on the right) crystal multiplicity versus total energy for 1h of data taking. The diagonal events in both figures correspond to fission and the bottom events on the right figure correspond to capture.

3 Conclusions and next steps

The second part of the experimental ^{233}U measurement was succesfully performed in June-July 2021 to complete the statistics needed above 10 keV. The complete set of experimental data is being analyzed. The fission tagging method has being succesfully implemented in the code, and the fission tagging efficiency will be improved for final analysis. The data analysis will continue during the end of the year 2021 and the year 2022.